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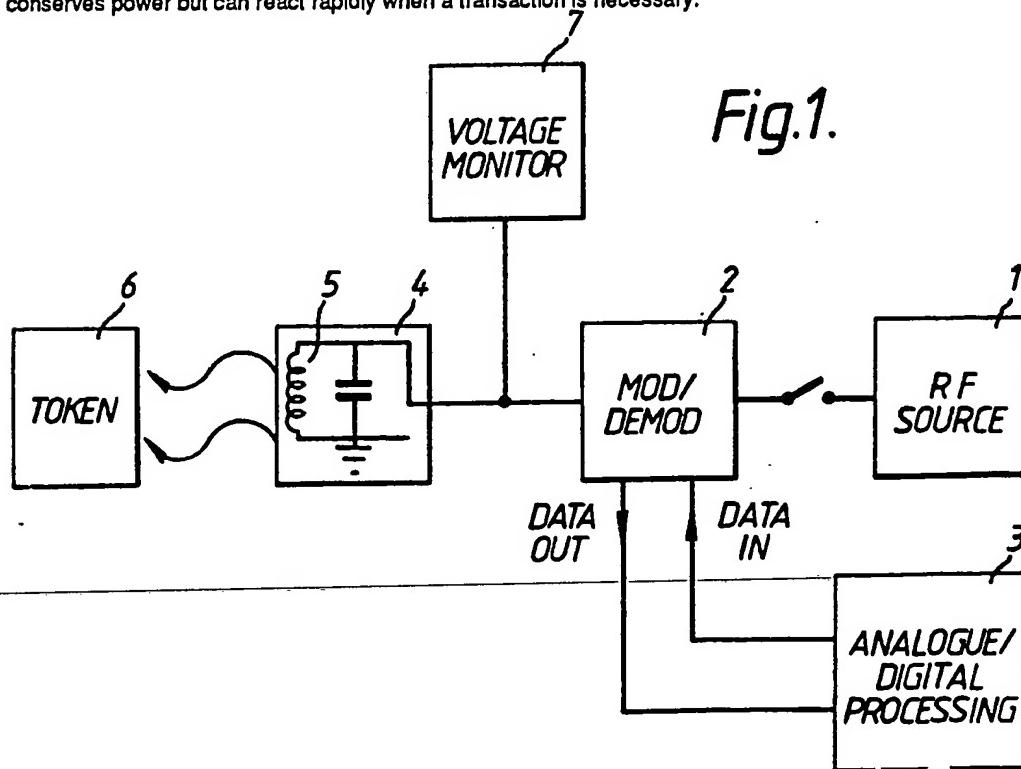
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None

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(54) Transaction system

(57) A transaction system includes a portable electronic token 6 and an external read/write unit which communicate by inductive coupling. The read/write unit transmits short pulses of an r.f. carrier when in its dormant mode and, upon detecting the presence of a token, switches its r.f. on continuously to power up the token and conduct a transaction. Thus, the system conserves power but can react rapidly when a transaction is necessary.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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1/4

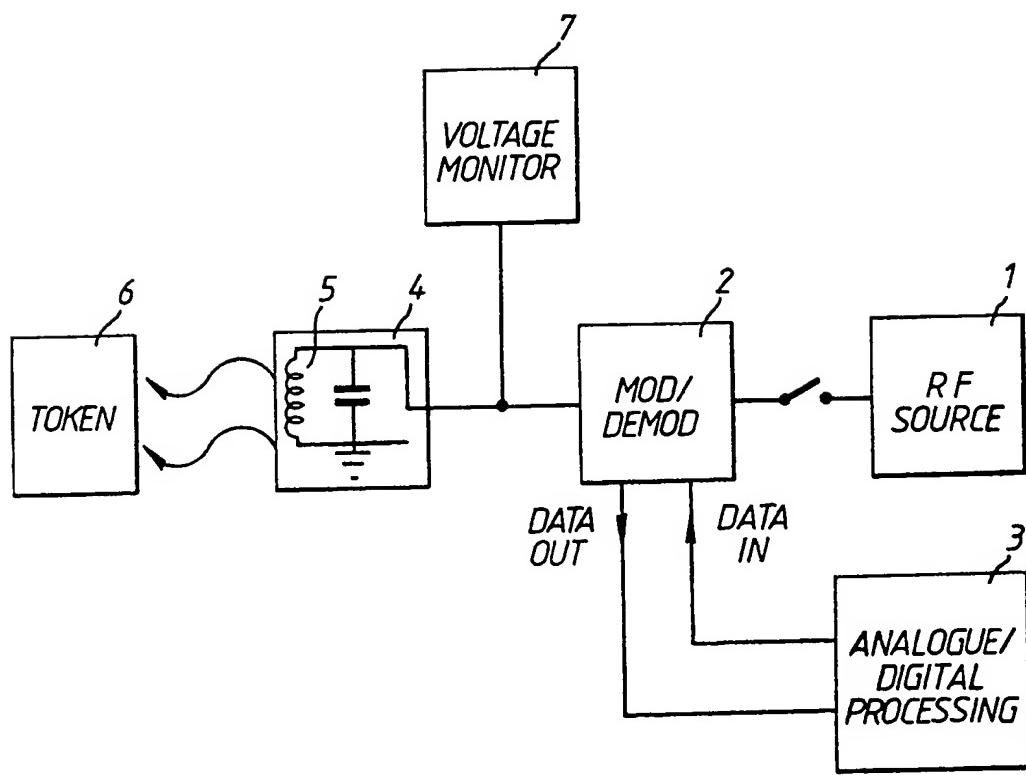


Fig.1.

2/4

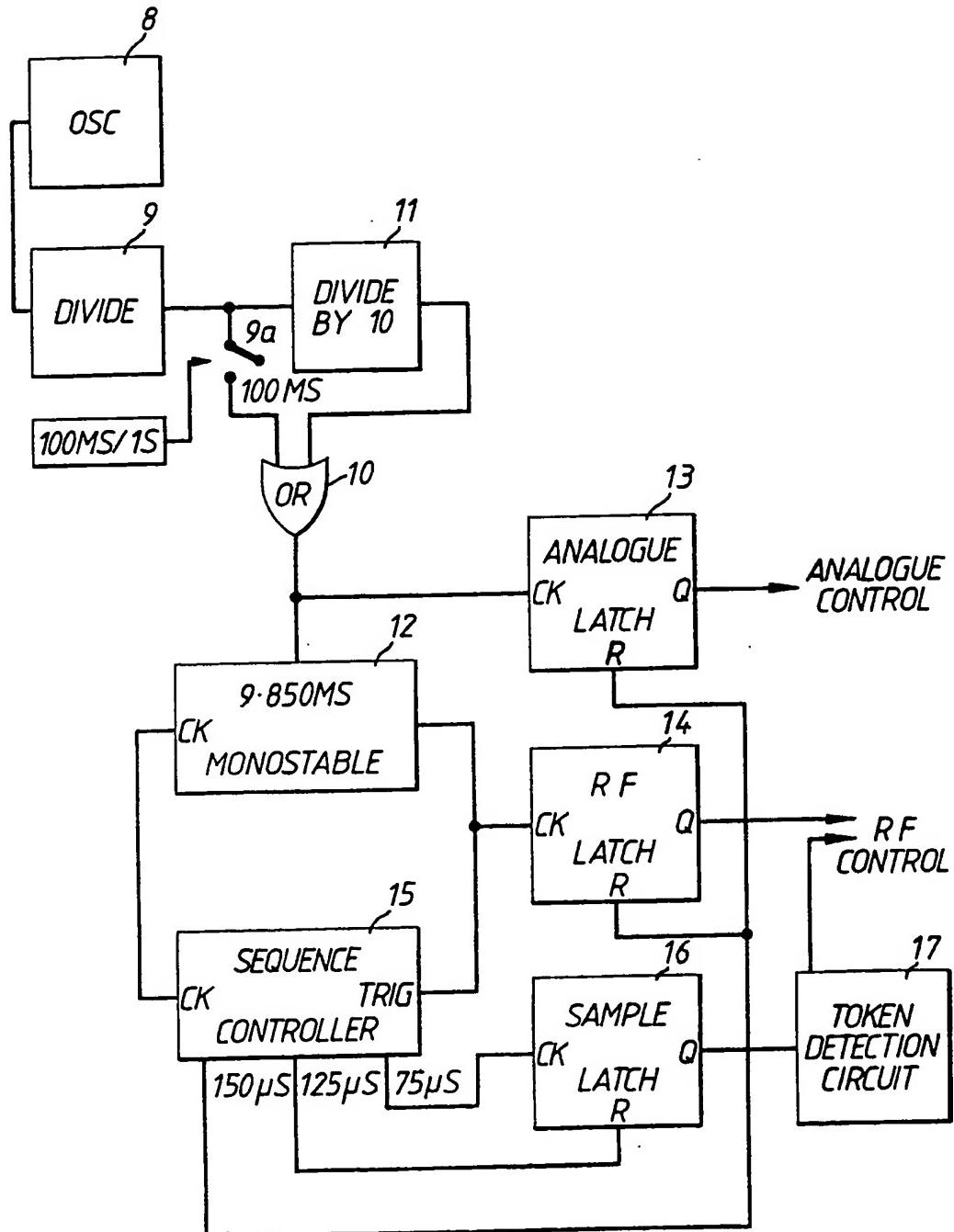


Fig.2.

3/4

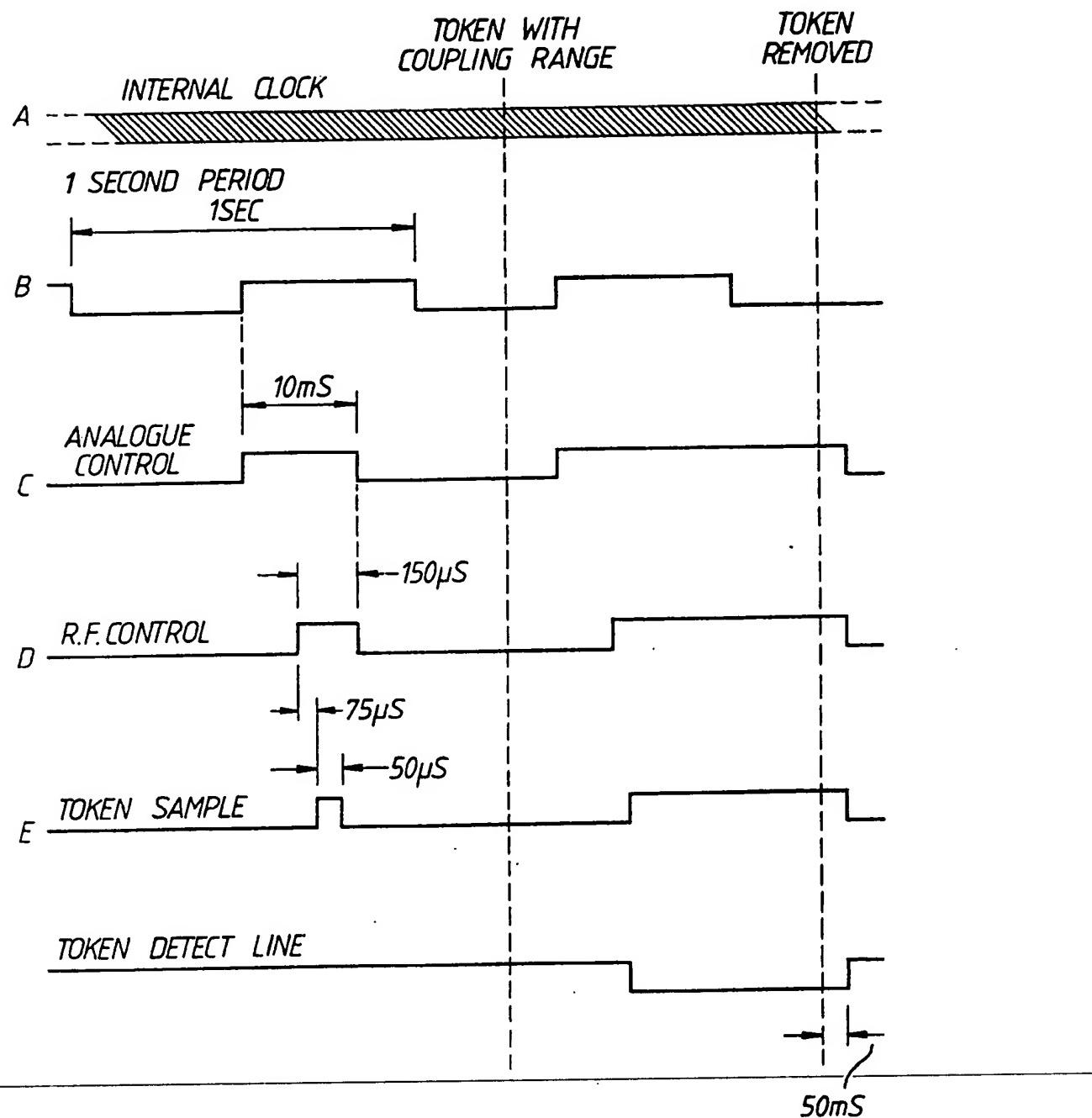


Fig.3.

4/4

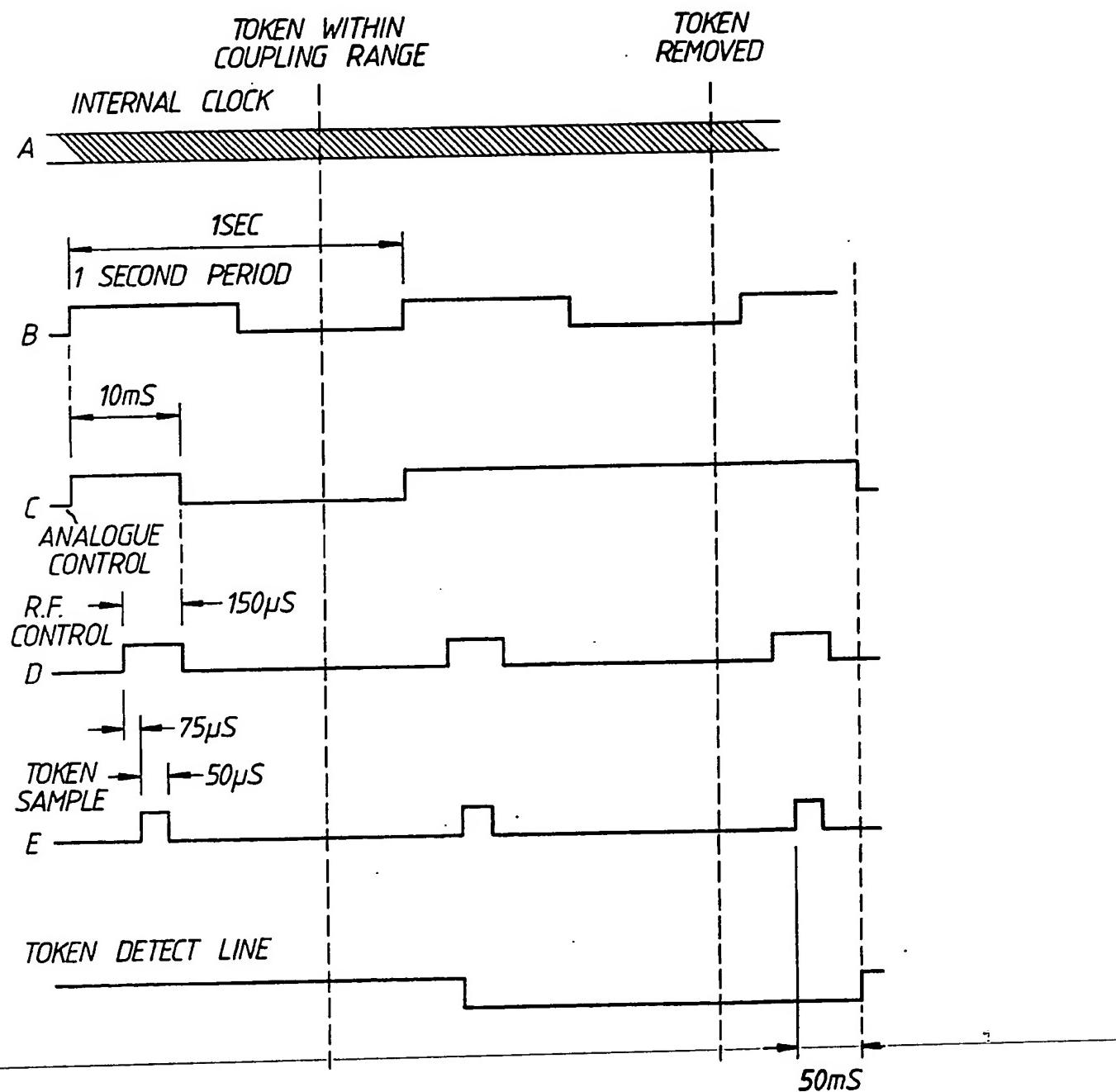


Fig.4.

- 1 -

Transaction System

This invention relates to a transaction system, and in particular it relates to a system including a terminal for reading from and writing to an electronic token which has an onboard data processing capability.

5 Such a token is often in the form of an elongate card and may be termed a "Smart Card". The terminal may be a stand alone unit with which data held within the token can be read or altered or alternatively the terminal may be connected by a remote or local link to an external

10 host such as a bank's computer.

Systems of this type have become well established in recent years and generally take the form of a terminal fixed at a certain place, such as a bank, and a token which is portable and is issued to an individual 15 who carries the token around and brings it to the terminal when a transaction is deemed necessary. The system may be of the contact type in which the token must physically touch the terminal in order for communication to be established or may be of the contactless type which utilises for example, inductive coupling. This invention is related to the  
latter-mentioned type of coupling.

- 2 -

- It is evident that in this type of system a terminal is in communication with a token only for short periods of time but it is important that when a token is brought towards the terminal the terminal recognises  
5 this and is able relatively quickly to establish communication. It is preferable that the user does not have to 'switch on' the terminal each time he wants to use it. Thus, in inductively coupled systems which use a carrier wave transmitted from the terminal to the  
10 token the terminal may be permanently energised so that when the token is brought towards the terminal it is immediately powered up. In an alternative form as described in GB 2208025 A the terminal is arranged to transmit the carrier signal at a relatively low stand-by level and, after detecting a token, to raise the level of the carrier to a higher level equal to the operating  
15 level. Since the carrier signal is permanently on, albeit at a low level, the terminal still consumes a considerable amount of power when in its 'dormant' mode.  
20 The present invention arose from a need to reduce still further this power requirement.
- According to the present invention there is provided a transaction system comprising first and second bodies adapted to communicate inductively,  
25 wherein the first body comprises means for generating

- 3 -

and transmitting radio frequency pulses, means for detecting whether the level of the pulse exceeds a threshold level within a chosen period of time equal to or less than the pulse duration, and means for indicating that the second body is in inductive proximity if the threshold level is not so exceeded.

Thus, a system embodying the invention pulses its carrier r.f. signal, and, if a token is brought into the proximity of the terminal then the r.f. level in that particular pulse will not exceed the threshold value since the token will draw power and thus reduce the level of the r.f. field. Once the token is sensed then the r.f. may be left on permanently and a transaction allowed to be conducted. When the token is subsequently removed then the r.f. level will raise again since less current is being drawn and hence will exceed the threshold, thus cutting off the permanent r.f. signal and reverting to pulsed mode.

In an alternative system, once a token is detected the pulse of r.f. is allowed to complete and the pulse cycle allowed to continue, but means are provided in the system for noting that the token is present and awaiting a signal from an external device, such as a host computer for example, to switch the r.f. on permanently. This may be useful in some particular

- 4 -

applications.

Preferably a pulse is transmitted once every second or once every 100 ms depending upon whether, respectively, low power consumption or quick response is required. The pulse width is typically of 150 microseconds.

In a preferred embodiment, the analogue circuitry in the terminal, which circuitry typically includes signal processing circuitry for processing data from the token to the terminal, is first powered up, typically for a period of 10 ms. In the last 0.15 ms of this 10 ms time period the r.f. pulse is generated. This is because the analogue circuitry requires a short time to settle down but must be settled to detect an 'answer to reset' character from a token, which happens a short period after the token is powered up by the r.f. from the terminal.

Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 shows schematically the elements of a read/write terminal.

Figure 2 shows schematically elements of a terminal in accordance with the present invention; and

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Figures 3 and 4 are waveform diagrams.

- 5 -

Referring to Figure 1 there is shown in block form elements of a terminal which is suitable for interaction by means of inductive coupling with an electronic token comprising processing means and memory means. The 5 terminal is of the type which transmits data by means of modulation of an r.f. carrier signal. In a typical example, data to be transmitted from the terminal to the token is transmitted by frequency modulation of the carrier wave and data from the token to the terminal is 10 transmitted by a level or amplitude modulation of that same wave. The terminal comprises an r.f. source 1, typically of 300 kHz which may be switched on and off or pulsed by apparatus which is further described below with reference to Figure 2. This carrier signal is fed 15 to modulation and/or demodulation circuitry 2 where either an FM modulation corresponding to data to be transmitted is applied to the carrier or level modulation from data received is detected. The data is passed to or from analogue and/or digital processing 20 circuitry 3. The modulated signal is passed to a tuned circuit 4 which includes an inductive loop 5. This generates a varying magnetic field which is detected by a similar loop on a token 6. A voltage monitoring circuit 7 monitors the signal at the tuned circuit 4 and 25 is used to detect whether a token is present or not

- 6 -

since a token, by drawing power, will lower the level of the r.f. signal. A switch 8 is shown schematically as a control switch for the r.f source.

Referring now to Figure 2 there is shown a system  
5 by which the output of the terminal can be controlled.  
The system comprises an oscillator such as a 12 MHz  
crystal oscillator 8 which is fed through a suitable  
divider 9 to produce a pulse once every 100 mS which is  
fed through a switch 9a to one input of an OR gate 10.  
10 The output from divider 9 is also fed to a divide by Ten  
unit 11 to produce a pulse at a frequency of one second  
which is fed to a second input of OR gate 10. An output  
from the OR gate is fed into a monostable 12 designed to  
switch states after a period of 9.850 mS. An output  
15 from the OR gate 10 is also used to initiate a latch 13  
which is used to control the analogue circuitry (not  
explicitly shown) in the terminal and is accordingly  
termed an analogue latch. The analogue circuitry is  
thus turned on once every 100 mS or 1 second depending  
20 upon whether the 100 mS signal is switched into the OR  
gate by switch 9a.

After a period of 9.85 mS monostable 12 is arranged  
to switch state and to feed a clock signal to an r.f.  
latch 14 which serves to actuate the r.f. source 1 of -

25 Figure 1.

- 7 -

Simultaneously, a sequence controller 15 is triggered by a signal from monostable 12. The sequence controller is designed in this embodiment to give three outputs at different time periods after triggering.

5 After a period of 75 microseconds a signal is fed into the clock input of a sample latch 16 which serves to actuate a token detection circuit 17; this is equivalent to the voltage monitor 7 of Figure 1 and essentially detects whether a token is present by monitoring the  
10 voltage on the r.f. line using standard techniques.

After a further period of 50 microseconds, i.e. 125 microseconds from triggering, the sample latch is reset and sampling is ceased. 25 microseconds later ( $150 \mu\text{s}$  after triggering), the r.f. and analogue latches 14 and  
15 13 are reset thus switching off the r.f. and analogue signals. Hence, the analogue circuit has been 'turned on' for 10 mS and the r.f. has been 'turned on' for 0.15 mS. A threshold value is set, above which the r.f. level will rise when a token is not present, but which  
20 is of such value that the presence of a token within a chosen range causes the r.f. level not to exceed or to fall below the threshold value. The value is easily determinable, depending upon the application, component values, power requirements, etc.

25 The above assumes that a token is not detected

- 8 -

during the 50  $\mu$ s sample period. If a token is detected then the system may operate in two alternative modes. In a first mode, when a token is detected by the pulse not exceeding a threshold value within a fixed time 5 limit (usually smaller than the pulse duration) then the r.f. source is not switched off. Instead the r.f. is left permanently on so that contact with the token can be established and a transaction, such as a financial transaction, conducted. The analogue circuitry is also 10 left on during this period. The manner of conducting a transaction does not form part of this invention and is omitted herein.

Once the token is removed then the token detection circuit 17 which has been left permanently on, in 15 addition to the r.f. and analogue circuits, senses that the level of the r.f. increases above the threshold value and thus turns the r.f. and analogue signals off. The system then reverts to its pulsing mode and pulses the analogue and r.f. circuits every 100 mS or 1 second 20 as selected. A delay may be imparted into the system such that once it has been detected that the token has been removed the r.f. and analogue circuits are turned off after a fixed delay period. This process is shown more clearly in Figure 3 where A represents the internal- 25 clock frequency of 12.218 MHz. Waveform B is for a

- 9 -

system where the pulse is initiated once every second and shows a one second pulse. Waveform C shows how the analogue circuitry is switched on for a period of 10 mS when a pulse is output from OR gate 10. Waveform D 5 shows how the r.f. source is switched on for the last 150 microseconds of this period. Some  $75\mu s$  later the token sample or detection circuit 17 is switched on as shown at E, for a period of  $50\mu s$ . If a token is introduced at any time then the token detect line will 10 introduce at any time then the token detect line will detect it and thus, as shown in the second portion of Figure 3, will leave the analogue r.f. and token detect lines open. Removal of the token is detected by the token detection circuit which, after a delay of 50 mS in this example switches off the analogue r.f and token 15 sample circuitry. Pulsing is then re-established.

It should be noted that the waveforms in Figure 3 and Figure 4 are not to scale.

Figure 4 shows an alternative mode in which the first part, when a token is not present, is identical to 20 that in the first mode. However, as shown in the second part of Figure 4, once a token is brought into the proximity of the terminal then the token detection circuit notes this but, instead of leaving the r.f. permanently on it allows it to be switched off at the 25 end of its pulse period of 150 microseconds. The

- 10 -

analogue circuitry is however left on permanently and also a flag is set in the system so that an external device, such as a host computer, can give a message to turn the r.f. on. The system is thus seen as being  
5 'primed' for operation once a token is detected but operation is not actually initiated until an external device instigates it. This system may have advantages in certain applications. Upon removal of the token from proximity of the terminal the token detect line detects  
10 this removal, and, after a 50 ms delay resets the analogue control to off and enables pulsing to begin again.

Although the inductively-coupled bodies have been termed terminal and token in this specification, the  
15 invention is not limited in this regard and is suitable for use between any two bodies which communicate by means of inductive or other contactless coupling.

- 11 -

CLAIMS

1. A transaction system comprising first and second bodies adapted to communicate inductively, wherein the first body comprises means for generating and transmitting radio frequency pulses, means for detecting whether the level of the pulse exceeds a threshold level within a chosen period of time equal to or less than the pulse duration, and means for indicating that the second body is in inductive proximity if the threshold level is not so exceeded.  
5
- 10 2. A transaction system as claimed in Claim 1 wherein the first body is a read/write terminal and the second body is a portable token having onboard data processing capability.
- 15 3. A transaction system as claimed in Claimed 1 or Claim 2 wherein the indicating means comprises means for enabling the r.f. signal to be left permanently on until the removal of the second body is detected, whereupon pulsing of the r.f. is re-established.
- 20 4. A transaction system as claimed in Claim 1 or Claim 2 wherein the indicating means comprises means for

- 12 -

setting a flag or other indicator which is detectable by  
an external host to switch the r.f. on continuously.

5. A transaction system as claimed in any one of the  
preceding claims wherein analogue circuitry within the  
first body is also pulsed until the second body is  
detected, at which point it is left permanently on until  
the body is removed, the analogue pulses being actuated  
for a period of time prior to and during each r.f.  
pulse such that the analogue circuitry can be fully  
10 powered up before the actuation of each r.f. pulse.

6. A transaction system as claimed in any preceding  
claim wherein the pulse frequency is selectively one of  
two or more different values.

7. A transaction system as claimed in Claim 6 wherein  
15 the values are one second and 100ms.

8. A transaction system as claimed in any one of the  
preceding claims wherein the r.f. pulse duration is 150  
 $\mu$ s.

9. A transaction system as claimed in any one of the  
20 preceding claims wherein analogue circuitry on the first

- 13 -

body is actuated for periods of 10 mS and the r.f.  
pulse is actuated during the final 150  $\mu$ s of the 10 mS  
period.

10. A read/write terminal, adapted for use as the first  
5 body as claimed in any one of the preceding claims.

11. A transaction system substantially as hereinbefore  
described with reference to and as illustrated by any  
one of the accompanying drawings.